

INTEGRATED PLANAR COMPOSITE COUPLING STRUCTURES FOR BI-DIRECTIONAL LIGHT BEAM TRANSFORMATION BETWEEN A SMALL MODE SIZE WAVEGUIDE AND A LARGE MODE SIZE WAVEGUIDE

ABSTRACT OF THE DISCLOSURE

Composite optical waveguide structures or mode transformers and their methods of fabrication and integration are disclosed, wherein the structures or mode transformers are capable of bi-directional light beam transformation between a small mode size waveguide and a large mode size waveguide. One aspect of the present invention is directed to an optical mode transformer comprising a waveguide core having a high refractive index contrast between the waveguide core and the cladding, the optical mode transformer being configured such that the waveguide core has a taper wherein a thickness of the waveguide core tapers down to a critical thickness value, the critical thickness value being defined as a thickness value below which a significant portion of the energy of a light beam penetrates into the cladding layers surrounding the taper structure thereby enlarging the small mode size. This primary tapered core structure may be present in either a vertical or horizontal direction and may be combined with further up taper or down taper structures in the directions transverse to the primary taper direction. Another aspect of the present invention is directed to a non-cylindrical graded refractive index (GRIN) lens structure. The non-cylindrical GRIN structure has a graded refractive index having a maximum value at its core and a minimum value at its outer edges. The grading of the refractive index is provided in either the vertical or horizontal directions and may have either a fixed refractive index or a graded refractive index in the transverse directions. Yet another aspect of the present invention is directed to composite optical mode transformers that are combinations of the taper waveguide structures and the non-cylindrical graded refractive index structures. Yet another aspect of the present invention is the further integration of the mode transformers with V-grooves for multiple input/output fibers and alignment platform for multiple input/output photonic chips or devices.